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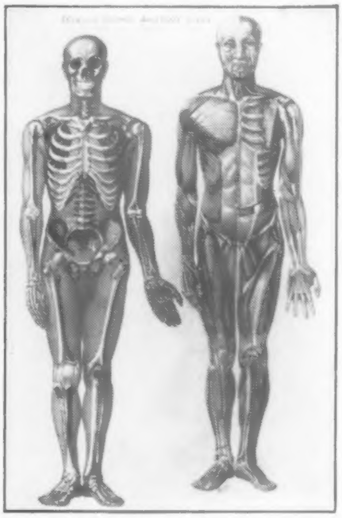

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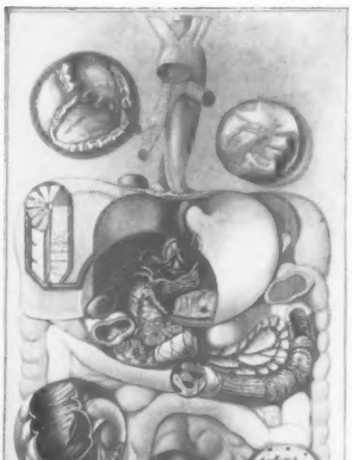

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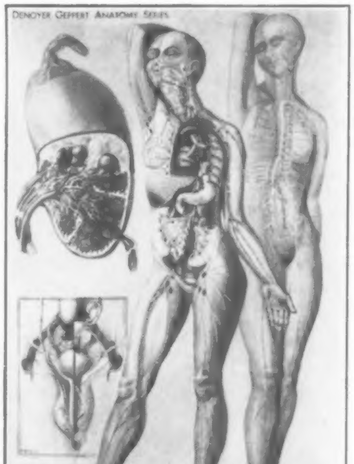

Chart KL7 Lymphatic System

The American Biology Teacher

Vol. 12 MAY 1950 No. 5

Objectives and Grades in Biology

JESSE V. MILLER
Manhasset High School, Manhasset, New York.

Modern educational philosophy places emphasis on developing *children* by means of problems and subjects rather than on the development of *subjects* by the use of children. The child and his needs comes first. If a choice is to be made between the needs of the child and the teaching of the subject, the child comes first. A teacher who replies, "I'm hired to teach biology, and I haven't time to teach this other stuff and still get them through their exams"—is considerably off the beam in his philosophy.

Biology materials are excellent for developing many of the goals useful to the child in solving all sorts of life-problems. The emphasis should be on the *goals*, however, not on the subject. And of course most of the goals should be useful in solving the problems children think and worry about, not on those *we* think they should be worrying about. A little anticipation of a student's future needs is not ruled out-of-order, but it is questionable whether we should accept many goals of this sort.

Most high schools with which the author is familiar are still using an *A-B-C* grading system or some equivalent. A little progress has been made by adding a so called *attitude* rating in numbers. Thus a student receives a C–3. Upon reading the key on the report card a parent learns this means—"C = 70–79;" "3—attitude passive, indifferent."

It is difficult to see how such a rating could be determined or justified if we were really doing all we could to help each of our students to meet his needs. The grading system itself seems to reflect our failure to think and teach more than the "8 out of 10 facts on his tests" philosophy. Another interpretation of "C" might be—"He does about as well as the *average* of his class". This also fails to indicate what he failed to do well, what he did well, or what he neglected to do at all.

It seems to me we need to re-evaluate our philosophies of education in terms of the needs of the human beings we teach in 1950. We should then be able to change our courses and teaching methods,

if need be, to better undertake the meeting of these goals. A reporting system which will be meaningful in terms of these goals will be the next logical development.

It would be helpful if a great many more teachers who are trying more effective techniques in their classes would write up their experiences and make them available to others. Just a list of schools where such teaching is being done would be valuable to teachers who wish to plan visits.

Excellent articles have appeared lately in *The Clearing House* (Heredity) (1), *Planning For American Youth* (Ten Imperative Needs of Youth) (2); and *Progressive Education* (3). Materials of use in broadening our teaching may be found in the booklets *Two Lessons of Group Dynamics* (4), and *A Guide for Diagnosing and Correcting Science Errors* (5). Every teacher of biology should be familiar with the most recent science yearbook *Science Education in American Schools* (6), and *Science in General Education* (7). Excellent suggestions for evaluation are to be found in (6) and (7) above, and in *The Measurement of Understanding* (8). Suggestions for revising a biology course were included in *Biology—1949 Model* (9).

The author is now experimenting with a rating sheet which summarizes the objectives a biology teacher might expect to emphasize in his teaching. The list is by no means complete, and not all would be attempted with every student. The ratings are used as a basis for helping

RATING SHEET

Work Habits
- Shows initiative
- Is persistent
- Organizes work
- Meets commitments promptly
- Completes jobs
- Records new ideas
- Attentive
- Contributes to group
- Talks before group
- Shows emerging leadership
- Has high standards of accuracy

Thinking
- Open minded
- Demands evidence
- Suspends judgment
- Cautious in statements
- Recognizes nature of *facts*
- Recognizes nature of *inferences*
- Disagrees tactfully
- Shows intellectual honesty

Problem Solving
- Senses a problem
- Defines problems
- Recognizes pertinent clues
- Makes good hypotheses
- Tests likely hypotheses
- Discards, tries new hypotheses
- Recognizes nature of proof
- Draws valid conclusions

Attitudes and Appreciations
- Respects opinions of others
- Has positive learning attitude
- Appreciates cause-effect relationship
- Shows constructive group behavior
- Attitude permissive

Instrumental Skills
- Reads with understanding
- Performs operations accurately
- Manipulates equipment well
- Reads and interprets:
  - Maps
  - Graphs
  - Charts
  - Tables
- Makes accurate measurements

Memorizes and understands
- Facts
- Concepts
- Principles

Shows desirable interests

each child to recognize his strengths and to overcome his weaknesses. It is presented on page 100 in the hope that it may prove useful to others.

A reporting system has also been devised for trial which seeks to make the above mentioned "C–3" method of grading at least partly meaningful. We had no choice but to use this system, at least for the rest of this school year. A committee of parents, teachers, and administrators is now working on a revision which may be completed for next year. That has not, however, prevented the Practical Biology classes from discussing and agreeing to a set of reportable goals by which some of their strengths and weaknesses could be indicated as a basis for the "C–3". This form is reproduced below. We would appreciate your suggestions for improvements, or information on other plans in use which may be more meaningful.

REPORTING SYSTEM

Achievement Rating

______ A. Outstanding

______ B. Above Average

______ C. Average

______ D. Below Average

______ E. Unsatisfactory. Lack of effort indicated.

Basis for Achievement Rating

______ Tests—Oral, written

______ Experiments—written

______ Class Reports

______ Laboratory techniques

______ Progress in thinking

______ Projects—Educational value, ingenuity, organization, etc.

______ Any other measurable learning experience that improves a student's knowledge and understanding.

Parent's Signature ____________

Attitude and Application Rating

______ 1. Shows initiatve; does more than he has to. Shows ambition, drive.

______ 2. Cooperatve. Satisfactory in #1 and #2 below.

______ 3. Passive, indifferent. Unsatisfactory in #2 below. Appears to have little desire to learn.

______ 4. Disturbing. Visits too much in class, or otherwise interferes with efficiency of class.

______ 5. Obstructive. Immature attitude toward learning; constantly strives to disturb rather than contribute.

Basis for Ratings

#1. Class behavior ______

#2. Promptness of assigned work ______

#3. Progress in group participation ______

#4. Class contributions ______

#5. Work habits—attitude toward learning, persistence, etc. ______

#6. Evidence of initiative as shown by projects ______

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2. *Planning For American Youth* (booklet 25¢), *Education For All American Youth* (Book), Nat. Assn. of Secondary School Principals Assn., 1201 Sixteenth St., N.W., Washington 6, D. C.
3. Progressive Education (Journal of Am. Education Fellowship), Jan. 1949, *Building a Secure People* (theme), Apr. 1949, *A New Approach to Educational Method* (theme), May 1949, Educational Change and Social Engineering (theme of entire issue). Address under #7 below.
4. *Two Lessons of Group Dynamics* (booklet 25¢), Educators Washington Dispatch, Deep River, Conn.
5. *A Guide for Diagnosing and Correcting Science Errors*, Wilbur L. Beauchamp—Scott Foresman and Co., Chicago or New York. (about 5¢ each.)
6. *Science Education in American Schools*, National Soc. for the Study of Education, 46th Yearbook, part 1, 5835 Kimbark Ave., Chicago 37, Ill.
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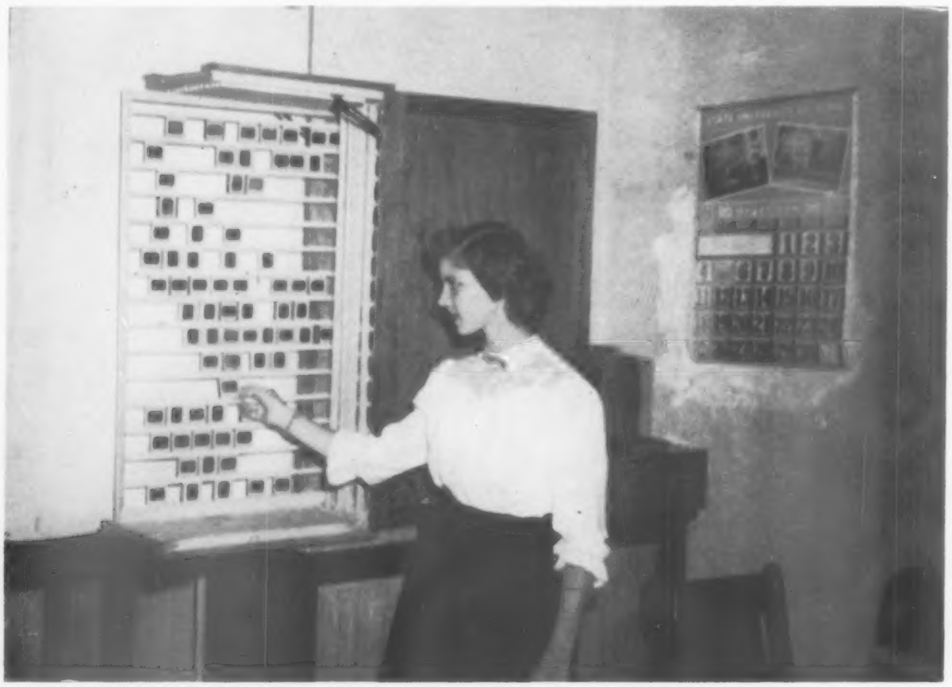
8. *The Measurement of Understanding*, 45th Yearbook, Part 1. National Soc. for the Study of Education, 5835 Kimbark Ave., Chicago 37, Ill.
9. *The American Biology Teacher*, April, 1949 (Vol. 11, No. 4) Biology. 1949.. Model. Jesse V. Miller.

A Filing Case For Kodachrome Slides

Photographing nature subjects in color provided us with about 500 2″ by 2″ Kodachrome slides. These were used in teaching and in club programs. However, storage and selection of the slides became a major problem. In the usual type of box housing them, each picture is concealed by nearby slides. It is also



stored upside down so that it is ready to slip into the projector. When we wished to select two dozen slides to show on highway beautification or Arbor day, we had to go through portions of the collection lifting each slide, turning it over, deciding to take it out for the showing or dropping it back into the case.

With such a large and growing collection this became a nuisance. Upon seeing the storage cabinets for slides in the Headquarters Museum of Yosemite National Park, we decided to have something more suitable for our needs.

Using our power saw we built a case 15 by 28 by 38 inches. The picture shows the young lady standing in front of it. This case holds 13 frames like the one shown in the picture and has a total capacity of 1,100 slides. Any slide may be lifted straight up and then the bottom of the slide can be slipped out of the rack just as the girl is doing.

The slides are numbered and filed accoring to a modified Dewey decimal system. If colored pictures of spring flowers are needed, the frame containing the 580's (Botany) is drawn out of the case. The divided door of the case opens downward and upward to provide guides and support for this frame. One may then look at and through any number of these slides without touching any except those which are to be withdrawn and used. Artificial lighting of the background is unnecessary because this frame is drawn out in front of a window.

The lumber for the case cost less than $10 but there is an excessive amount of labor involved. However, if one could get the manual training class to do the job for him, he could obtain a useful case for a small cost.

S. M. Pattee
Roosevelt High School,
Cedar Rapids, Iowa

The Study of Taxonomy

FREDERIC L. STEELE
Saint Mary's-in-the-Mountains, Littleton, New Hampshire

All high school courses probably devote some time to taxonomy. The textbook outlines the scheme of classification and then gives a brief explanation of each of the divisions, taking some animal such as the cat for an example. The pupils do not have much trouble in memorizing the scheme, but the problem of giving them an understanding of the significance of each of the divisions remains. As different animals and plants are studied in class and the laboratory, they will no doubt be classified. This will be of help, but further measures will be necessary to give the students an understanding of the significance of the system. A mastery of the principles of classification will not only enhance the value of field trips and expeditions to museums, but will add interest to any exploring done by the students after the course is over, even though they do not continue in biology.

Field trips are most helpful and certainly should be used whenever possible. They are comparatively easy to manage for schools in the country; more difficult for those in the city, but there is much that can be observed even in a city park. On our early fall field trips, which are devoted to plants, I try to give the students a concept of species and family. The students learn the common names of twenty or thirty common flowering plants. They are required to distinguish between some closely related species such

as red and sugar maples, or white and red pines. They also learn two or three well-marked species of goldenrods and asters. These groups are considered difficult, but many species have distinctive characteristics, and with the help of an illustrated guide it is not difficult to name several members. These flowers are common everywhere and are sure to be noticed on any fall field trip. Goldenrods and asters are easily accessible examples of different but related genera. I sometimes stress a few scientific names at this time. *Aster cordifolius* (heart-leaved aster), for example, is not difficult for students to learn.

In the course of the trips the students learn to recognize a few of the common families of flowers and trees. We are not of course able to go into many of the technical distinctions between families, but we do stress some family characteristics based on flowers and fruits. The composite with many small flowers packed into a head and with specialized ray flowers is a family easily recognized. Goldenrods, asters dandelion, daisy, hawkweeds and others are common everywhere. The pea family has characteristic highly irregular corollas and pod-like fruits. Clovers are common and all students are familiar with the garden members of the family. The mint family with square stems, mustard with six stamens, and buttercup with numerous stamens and pistils are others that we examine. Among trees the maple family can be recognized by its fruits and the pine by its fruits and leaves.

While the major animal and plant phyla are being studied, it is often possible to stress the classes. Specimens of mosses and liverworts, the two classes of bryophytes, are easily secured and are displayed and studied in the laboratory. Ferns and club mosses, examples of two classes of pteridophytes, are readily collected. Technical distinctions are not stressed but differences in the leaves and sporebearing parts are apparent to all.

Most of the work in zoology is done with preserved specimens. We dissect only standard types, but have on display several samples of each major phylum, usually from different classes. During the study of echinoderms the students are given simple descriptions of the various classes, and then asked to place several animals in the correct class. The descriptions are modified versions of those given in any standard college zoology. Starfish, sea urchin, sand dollar, brittle star, and sea cucumber are included. The same procedure is followed with mollusks, and could be extended to other phyla if desired. During the study of vertebrates the students are required to know the names and characteristics of the leading classes, not a difficult procedure, as all are familiar with examples of each class.

The rank of order seems the least important of the various divisions of the classification system, and we do not put much emphasis on it. In botany it would involve technical distinctions not easily grasped. However in the class Mammalia all students are familiar with some of the orders and can readily appreciate the distinctions between them. The order Carnivora with well-marked families such as cat and dog, each with several familiar representatives, is most easily grasped. Several of the orders of insects such as bugs, beetles, or flies can readily be distinguished.

When there is an opportunity for field trips and collecting of specimens, the instructor can construct simple keys to be used by the students for identification. Some of the field guides have keys which are not difficult to modify for class room use. In this school we collect several species of club mosses in the fall. The following key based on Gray's *Manual of*

Botany has been used successfully:

A. Spore cases at base of leaves not forming a terminal spike
  B. Small plants, leaves less than ½ inch long, *Lycopodium Selago* (Alpine Club Moss)
  BB. Larger plants, leaves more than ½ inch long, *Lycopodium lucidulum* (Shining Club Moss)
AA. Spore cases in small reduced leaves forming a terminal spike
  B. Branches round and leafy on all sides
    C. Branches leafy up to spike
      D. Creeping stem deep in the ground, branches many times forked, *Lycopodium obscurum* (Ground Pine)
      DD. Creeping stem on surface of the ground, *Lycopodium annotinum* (Trailing Club Moss)
    CC. Spikes separated from leafy branches by short stems, *Lycopodium clavatum* (Running Pine)
  BB. Branches flat
    C. Branches leafy up to spikes, *Lycopodium obscurum* (Ground Pine)
    CC. Spikes on short stems in clusters of 3 or 4, *Lycopodium complanatum* (Ground Cedar)

We use common names, but it might be desirable to retain the scientific ones. The key can readily be used even though only 3 or 4 of the 6 species mentioned are available.

In the spring we study botany rather intensively, using a key to families of trees and flowers known to be common in this region. Several laboratory periods are devoted to the identification of plants that have been previously collected by instructor and students. The key is based on characters of the families as stated in standard guides. Descriptions of the species within the families are supplied to complete the identifications. The students have little difficulty in understanding the technique involved in the use of the key. There are errors in identification, of course, but all are interested in the work, and become aware of parts of the plant that otherwise would not be noticed. Insects are abundant everywhere and it should not be difficult to construct a key to some of the common orders and families likely to be found. Keys to reptiles and amphibians are available at many museums. Actual practice in identification by the use of keys seems to be most helpful in giving students an understanding of the methods and problems of classification.

LETTERS

Dear Sir:

Enclosed is an article and photograph which I am submitting for publication in the American Biology Teacher.

I was much impressed by an article in the magazine several years ago concerning the use of certain National Geographic Magazines in teaching bird study. Perhaps this was because I had been using them for a number of years in classes or because I have a collection complete back through 1916 and have many duplicate copies.

I have not been able to locate this article in back issues of *The American Biology Teacher.* However, I would be pleased to submit one or more short articles calling attention to additional uses of these fine magazines.

Now I may be influenced in this by the fact that I have more duplicate National Geographic Magazines than I use. I do hate to see them destroyed. I do wish that more of them could get into the hands of people who would cherish or use them.

Teachers will accept them as gifts but I have found no way to distribute my copies without financial loss.

Respectfully,

S. M. Pattee
Roosevelt High School,
Cedar Rapids, Iowa

Mosquito Mysteries

Any GI who was in the tropics knows fully well that there was more to the war than killing time and Japs. There were many other things that had to be done away with before they did away with the enemy itself. The common mosquito not only bit hard and often, day and night, but sometimes left the victim a dose of malaria as a receipt.

Just as the typical American family sprays its front porch during hot summer evenings before going out to sit and talk, so the American Army acted to control the deadly pests before waging war. Teams of soldiers were trained and sent out to do this job, and in many instances, this control work was carried out under actual combat conditions. Throughout the day and night, mosquitoes were collected, where they gathered to feed, breed, or rest. Hardly a stone was left unturned as the men searched for the secret hiding places of the flying blood-suckers. The insects were *identified,* so that the control units knew exactly who *their* enemy was; *counted,* so as to determine the proportions of the various species present in the area and in order to learn something of their habits; and finally, *dissected,* in order to determine the species actually carrying malaria.

After the habits of the adults were known, the larval stage, living in water, was searched for. When repeated collections were made in the dozens of types of habitats—rain-barrels, mountain streams, lakes, ponds, rivers, and others—and the larvae identified, it was then decided where the worst mosquitoes were breeding and what could be done to control them.

Very often there would be forty or more different kinds of mosquitoes present in an area, but only one or two of these would be carrying malaria to the soldiers. Some could be found breeding in rain-barrels, others in road-side puddles, still others in the various other types of habitats. Oddly enough, for the most part, they seemed to select a definite type of breeding place and usually could be found only in that kind of water.

Because its dense foliage offered a place to hide from enemy planes, thick groves of bamboo, fifty feet high, were utilized as storage places for goods of war. However, almost immediately after the inner-most plants were cut down to make storage space, the hollow stumps, four inches or more in diameter, filled with water, and served as the breeding place for beautiful black and white mosquitoes whose constant daytime biting made the places uninhabitable. The problem was solved simply by plugging the holes with mud.

The reason for this selective breeding pattern of mosquitoes is one of the unsolved mysteries puzzling workers in the field. Do the insects actually select the type of habitat desired or do they distribute their eggs promiscously and let other factors in nature do the eliminating? If the latter is true, what are these factors?

Another mosquito mystery is why only one or two kinds of mosquitoes out of all those present in an area is capable of carrying malaria. Very often the mosquito which is most deadly in one area is absolutely harmless in another. In Assam, India, *Anopheles minimus* is a horribly dangerous species whereas, *Anopheles philippinensis,* which is equally as abundant, is practically harmless. Oddly enough, five hundred miles southward down the valley, in Bengal, *Anopheles philippinensis* is the principal carrier of malaria. "Over the Hump" in China, a variety of *Anopheles hyr-*

canus is the killer. In Assam, a variety of that species is the most common mosquito and absolutely harmless.

To solve these mysteries perhaps it will be necessary to do as a good malariologist once suggested to his students; "To become a good malariologist one has to learn to think like a mosquito."

CHARLES O. MASTERS,
*4357 Jennings Road,
Cleveland 9, Ohio*

Growing Moss Protonemata

Moss protonemata were grown in our laboratory following the suggestions given by Johansen.* The medium used has ingredients as follows:

Distilled water	1 liter
Ammonium nitrate	1.0 g.
Potassium sulphate	0.5 g.
Magnesium sulphate	0.5 g.
Calcium sulphate	0.5 g.
Ammonium phosphate	0.5 g.
Ferric sulphate	0.01 g.
10% aqueous potassium hydroxide	A few drops

The medium was sterilized in an autoclave and poured into sterile Petri dishes. Spores from freshly opened capsules were scattered as evenly as possible over the surface of the liquid in the dishes. The cultures were kept in bright light at room temperature, in a Wardian case to conserve moisture. In the course of a week the spores germinated and began to grow into branching protonemata, but, as stated by the author, there was little tendency to produce gametophoric buds.

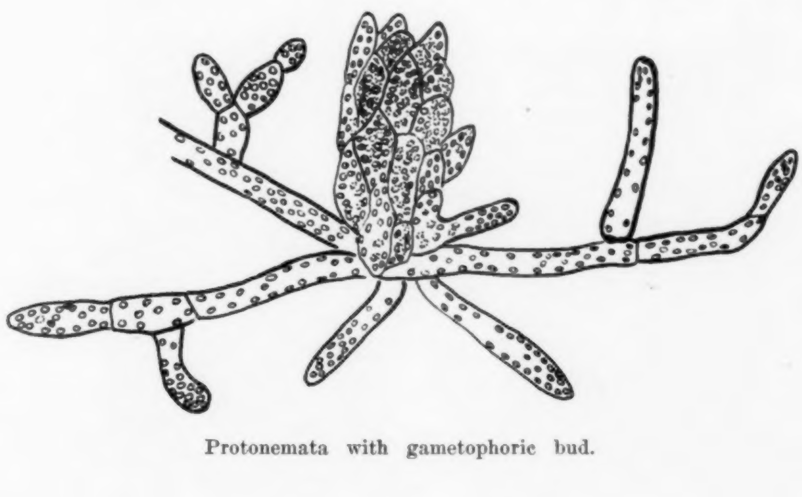
Results with the same medium to which 0.75% agar has been added were much better and in a few weeks, cultures with this medium were producing gametophoric buds.

Young plants taken from their native habitat and transferred to dishes with the agar medium were surrounded in a few weeks by a profuse growth of protonemata with developing gametophoric plants.

Typical prothallia were readily produced when dishes with the agar medium were sown with fern spores.

SISTER MARIA LAURENCE,
*Marywood College, Scranton,
Pennsylvania*

* JOHANSEN, DONALD A., *Plant Microtechnique*, McGraw-Hill Book Co., N. Y. 523 pp. Illus. 1940.



Protonemata with gametophoric bud.

Editorial Comment

Some Queries, Mr. Editor

Scientific courses are more or less standardized. They are the highways by which an abundance of valuable and interesting factual data of certain kinds are presented to the student. They are designed to develop in the student a scientific attitude—a point of view. A good course in science should make the student critical in approach, careful in procedure, and logical in analyses. The scientific course, well taught and comprehended, should give the student a moral value that will aid him to successfully solve some of life's problems.

Now a good scientific course is not a snap course, a bread and jam session where lazy students cull credits for transcripts. It is a sequence of supervised and directed study sessions and laboratory hours that call for cerebration, concentration, effort, and more effort. It gives *quid pro quo.*

The average student who signs up for a science course is disposed to work. He expects a challenge and wants to master the situation—subject matter, vocabulary, knotty experiments, scientific problems—everything. He is young and enthusiastic and will tackle the course with characteristic American cockiness—if he is permitted.

Why should scientific terminology be simplified for him? Why substitute "simple words" or slang phrases for distinctive, scientific phraseology that is purposeful and pointed? Why step down educational levels? We need not assume that the present generation of students is endowed with less ability than the parental generation who passed similar courses. Do we not insult both parent and progeny by catering to mediocrity?

The caliber of several of the radio programs that come into our homes over the air today suggests the following query: What per cent of the radio audience do they truly satisfy? Hours are filled with skits or plays lacking in thought content. The language used is ordinary and there is little success in achieving that cultured and refined atmosphere which we would like to call American.

We have young Americans in our science class rooms. Should we also simplify course content and speak in monosyllables in order to facilitate accomplishment for the average student? Is it not frequently true that the average student suffers from a prolonged attack of chronic negligence or inherent laziness rather than from lack of ability?

If it is necessary to simplify, we can. As educators we want to reach and serve our students, but does simplifying phraseology necessarily clarify? Take the matter of simplifying phrases as suggested in the *Editorial Comment* in the December ABT. Isn't accuracy sacrificed when "front end" is substituted for the phrase "anterior portion of the body axis"? Is *cranial* or *superior* meant, or is it *anterior* as opposed to *posterior* or *dorsal?* The young student might be confused by inaccurate terminology because *front* means *head end* in the case of the quadruped and *front view* or *face view* when the biped is in question.

Again problems of the reversible nature of protoplasm might be suggested to the student of science by the phrase "subzero temperatures produce complete immobility" while the fact that a plant or animal is "frozen stiff" suggests the need for a mortician.

"Insects with the regular number of walking legs" should suggest to the thinking student that there is a pattern

plan for insect legs; that unlike the vertebrate, they occur on the thoracic region of the body; and that there may be other kinds of appendages. The statement that "Insects regularly have six legs" calls for a period or a great amen.

It seems to me that in nearly every case for which simplified phrasing has been suggested by the editor, the original scientific wording conveys a better and clearer idea as regards biological phenomena which, at best, are complex.

Recently after a first lecture to a group of freshmen on health topics a husky 17-year 6-footer approached me and said: "That was a pretty stiff lecture. I didn't understand all the big words."

I looked him over, made a judgment and replied. "That is one of your present problems. You have a text and there is an unabridged dictionary in the library. Go to work." He smiled and said "O.K." The next day he had the assignment.

M. Anthony Payne, O.S.B.
Donnelly College,
Kansas City, Kansas

A Partial Reply

The editorial on "words" which appeared in the December issue called forth many responses. One of them, the only one that disagreed, is for that reason presented above. In view of the question whether accuracy isn't sacrificed when "front end" is substituted for the phase "anterior portion of the body axis," perhaps further comment is desirable. The editor obviously did not make his point clear enough.

In the article in question, the writer was describing structures in and near the front end of the earthworm; no question of accuracy was involved. He actually meant "front end" rather than "anterior portion, etc." This is not to say that "front" is *always* a satisfactory substitute for "anterior." The writer who commented on the "complete immobility" had nothing about the nature of insects or their protoplasm in his article—he only wanted to say that they were immobile on account of the cold and later in the article referred to them several times as frozen. There is no implication here that "frozen stiff" is *always* as good as "changed by subzero temperatures to complete immobility." And the man who said that "in the Insecta the regular number of thoracic walking appendages is six" was emphasizing the "six" as compared to the "eight" of spiders. The change does not suggest that the statement "insects regularly have six legs" would *in all cases* be as adequate as the longer statement.

All the editor was trying to say was that whenever a brief statement is as clear as a long one, the brief one is preferable. When for accuracy or clarity a longer statement is better, it should be used, of course. Sometimes "winter" is better; sometimes "season when average temperatures drop below the freezing point" is better. Only the context can determine which case is which—but when "winter" will do, why not use it?

Editors develop a word complex that is hard to describe. They encounter so many cases of redundancy and verbosity and so few of the opposite that they are always on the lookout for places to cut. No doubt most of them at times want to cut too deep.

Reviews

Sarton, George. *The Life of Science;* Essays in the History of Civilization. Henry Schuman, New York. vii + 197 pp. 1948. $3.00.

This little book is a collection of essays written over a period of thirty years by a Professor of the History of Science in Harvard University. The book has been prepared for the general reader. Much of it is within the range of interest and comprehension of high school students. The author's aim is to introduce the reader to the history of science, its scope, purpose, and methods. The topics chosen lean heavily on the physical sciences and mathematics, although there are numerous cases cited from the biological sciences. The titles of the essays follow:

The Spread of Understanding; The History of Medicine Versus the History of Art;

The History of Science; Secret History; Leonardo and the Birth of Modern Science; Evariste Galois; Ernest Renan; Herbert Spencer; East and west in the History of Science; An Institute for the History of Science and Civilization; Casting Bread upon the Face of the Waters.

There is an index.

Edward C. Colin
Chicago Teachers College
Chicago, Illinois

Duncan, Winifred. *Webs in the Wind.* Ronald Press, New York. xv + 387 pp. illus. 1949. $4.50.

"A spider's face is pretty awful until you get fond of it," says Winifred Duncan, who is evidently quite fond of awful faces. "It has long been my intention," she says, "to select some little creature concerning which I knew nothing, make a careful study of its life, and write a book about it which would take the reader along with me, step by step, on a voyage of discovery. That's where the magic is, the shock of delight and incredulity, the fun of finding things out, of making mistakes, of blundering on fascinating secrets." Abundantly illustrated with sketches, the journal-narrative traces two years' work on web-weavers. It is occasionally anthropomorphic, but the observations are provocative for both the casual hobbyist and serious researcher in animal behavior.

Richard F. Trump,
Senior High School,
Ames, Iowa

Williams, R. O. *School Gardening in the Tropics.* 3rd ed. Longmans, Green and Company, London. 143 pp. 1949. 3/–.

Mr. Williams, formerly Director of Agriculture in Zanzibar, compiled this book from a revision of material given in lectures for teachers in Trinidad in 1921. The book is small and paper-bound, illustrated with small drawings, and contains an appendix with a list of the common and scientific names of plants useful in tropical school gardens. Some of the topics discussed include: The object of a school garden, experimentation in plant production, how to relate gardening to other school work, as well as practical suggestions about cultivation and fertilization of the soil, selection of plants, planning the garden, care of plants, plant pests and diseases with suggestions for eradication, and hints about how to deal with land of different physiographic natures.

The tropical nature of the material necessarily limits its specific application in the United States, but the book is of interest as an example of what may be accomplished with garden project work, especially in the more rural communities. It may also serve as an impetus for those who might be qualified to assemble a similar compilation for teachers of temperate climates.

J. Patricia Cunnea
University of Chicago,
Chicago, Illinois

RENT-FREE VACATIONS

An opportunity to enjoy a rent-free vacation in any region of the United States is currently being offered to members of the teaching profession by the Teachers Residence Exchange. School and college instructors who register with the exchange are assisted in locating similarly-situated colleagues who wish to exchange homes for the summer or during a sabbatical leave. Officials of this unique service report keen interest among educators all over the country. California, New York, the southwest, and New England are the sections most popular with teachers seeking rent-free vacations, according to Mrs. Mildred Lewis, director of the residence exchange.

"Teachers wish to live in neighborly friendliness and are glad to really get to know the people and the way of life of the region they choose for their vacation," stated Mrs. Lewis. "Exchanges are made on the basis of complete information supplied by registrants," she added, "so that each teacher family finds a home very much like their own waiting to welcome them." Teachers interested in further information about the rent-free vacation plan should write to the *Teachers Residence Exchange,* 100 West 42nd Street, New York 18.

Suggestions for Laboratory Study of Human Eye Structure

CHARLES E. HADLEY
Montclair State Teachers' College, Upper Montclair, New Jersey

In too many classes of high school biology, students are unwilling victims of frustration and boredom. In large measure this is due to their exposure to a plethora of unconvincing imitations of the materials and phenomena which they seek to understand.

This unfortunate situation is well illustrated in the author's experience by feeble methods used in teaching the structure of the human eye. From the student's own testimony it is evident that the copying of a picture from the textbook followed by reference to a model of the eye is unconvincing and unsatisfactory.

There follows a description of materials and methods which, in the author's opinion, can go far toward improving the teaching of this unit. This description of the technique of preparing materials and the accompanying outline of laboratory study are here made available to the profession through the kindness of Professor R. L. Carpenter of Tufts College, their author.

The Eye—A Sense Organ

Of all five senses, sight is undoubtedly the most highly valued. The eye is, in many respects, a miniature constantly-recording camera. As you work with the preserved steer's eye, observe just how accurate this analogy is in terms of structure.

I. The Sectioned Eye

A. Source and Preparation of Material

Fresh steer eyes obtained from a nearby slaughter house are dissected clear of all superfluous fascia and fat which surrounds the sclera and optic nerve. The eyes are then placed in a 3% solution of formalin. After exposure to the formalin solution for not less than 24 hours and not more than 48 hours, the eyes can be bisected in a vertical plane with a flat-sided razor. If a test specimen, tried after 24 hours in the solution, cuts imperfectly due to the sticky condition of the lens, the remaining eyes can be cut satisfactorily after an additional 24 hours in the solution. Best results have been obtained by cutting from the optic nerve toward the cornea. Figure 1 shows in part details

Figure 1. Section of a calf eye showing cornea, iris, pupil, lens, ciliary body, optic nerve, and coats of the eyeball.

of eye structure which thrill the individual student studying the section first hand.

B. Outline of Laboratory Study

Notice the cornea and the lens through which light comes; the hemispherical posterior portion of the bulb, on the inner surface of which the image is formed, analogous to the film in the camera; and the optic nerve projecting posteriorly.

Observe the three well defined layers of the eyeball.

1. *Sclera*—the tough fibrous outer coat which is continuous in front with the *cornea*. The cornea is opaque and blue in the preserved specimen, but in life it is transparent and transmits light.
2. *Choroid*—within the sclera, the middle vascular layer, containing large amounts of brownish-black pigment. This pigment absorbs and reflects the light that passes through the—
3. *Retina*—This is the innermost layer and consists of nerve cells and fibres. It contains the light-sensitive visual cells, the *rods* and *cones*. Note the blood vessels coursing through it. What is the relation of the *retina* to the optic nerve?
   The *lens* separates two regions of the eye, anterior and posterior.

Each region contains a fluid-filled space. The fluids are:

1. *Aqueous humor*—the fluid between the cornea and the lens.
2. *Vitreous humor*—the jelly-like body between the lens and the retina.

The lens and the associated parts complete our study of the sectioned eye.

1. *Iris*—The iris is seen as a black curtain in front of the lens, more or less as a continuation of the choroid layer. The gap over the center of the lens, seen as a rounded opening when viewed from the front, is the pupil. The opening is increased or decreased in size depending upon the amount of light that is available to the eye. It is comparable to the camera's diaphragm. In cooperation with the student working next to you, observe the change in the diameter of the pupil as the subject looks toward the light and as he looks away from it.
2. *Ciliary Body*—The base of the iris is attached to the ciliary body, which can be seen as a dark band about one quarter of an inch wide, triangular in section. It extends back to the margin of the whitish retina. From the posterior surface of the ciliary body there can be seen a band of delicate grayish fibers extending to the equator of the lens. This is the *suspensory ligament*, which holds the lens in place and under tension. The suspensory ligament is in turn controlled by the ciliary muscle contained within the ciliary body.

Dissection of the Eye

A. Preparation of Material

Fresh steer eyes (cleared of extraneous material) which have been exposed to 3% formalin solution for any period of time from 9 days upwards can be dissected in detail as outlined below. This percentage of formalin preserves the eyes indefinitely while leaving them in condition for easy dissection.

B. Outline of Dissection and Study

The eye will be given to you in a bowl of water. Place the various parts of the eye that you remove back into the bowl to help keep them in good condition.

With your scissors, make a circular incision along the line of junction of the cornea and sclera. This will remove the cornea and expose the black iris with its

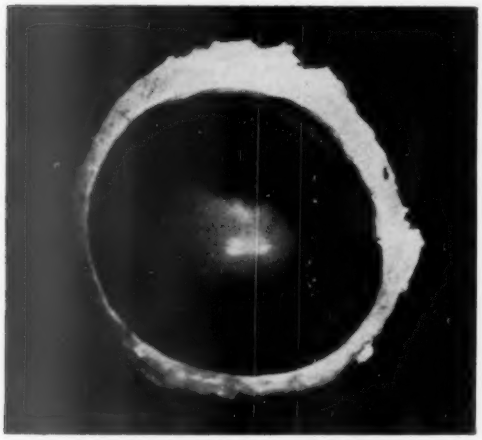


Figure 2. Front view of the anterior portion of a dissected horse eye showing sclera, iris, pupil, lens, and ciliary ring.

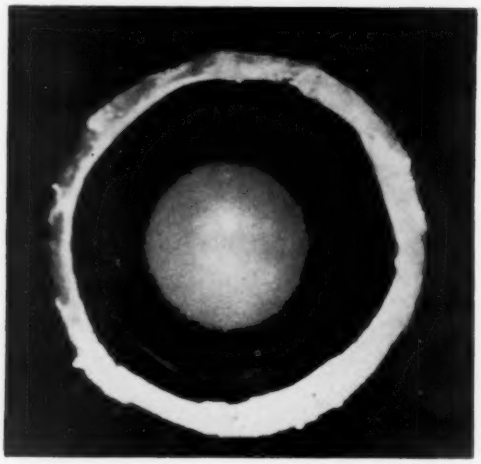


Figure 3. Front view of the anterior portion of a dissected horse eye after removal of the iris showing sclera, ciliary ring, ciliary processes, and lens.

central aperture, the pupil (see Figure 2). The lens can be seen through the pupil. With your forceps, probe the narrow space that lies between the iris and the lens. This is the *posterior chamber* of the eye. The space between the cornea and the iris is called the *anterior chamber*.

The iris is continuous with the ciliary body. Loosen the ciliary body from the sclera around its entire circumference by inserting your forceps, held tightly closed, and *GENTLY* breaking the attachments between the two layers. Take care to keep the tips against the sclera to avoid tearing the ciliary body. When a ring of the sclera about one half of an inch wide has been freed, cut it off. This will expose the outer surface of the ciliary body, which is delimited by a white ring, the *ciliary ring* (see Figure 3).

With your scalpel, make an incision just posterior to the ciliary ring, and, with your scissors, continue to cut completely around the eye. This will separate the ciliary body, iris, and lens from the rest of the eye, with the exception of the vitreous humor. Carefully free the anterior segment from the vitreous humor with your scalpel. Note the numerous radial folds around the posterior surface of the ciliary body. These are the *ciliary processes.* Carefully cut away the iris. This will expose the suspensory ligament, consisting of delicate fibers attaching the lens to the ciliary body. Remove the lens and note the Y-shaped sutures on both faces of the lens, the *lens sutures.* Put the lens aside to dry.

Observe the whitish *retina*, with its radiating blood vessels, the *retinal vessels.* Gently detach the vitreous humor from the margin of the retina. Carefully invert the eye and the vitreous humor should fall out. Carefully cut the retina away from its point of attachment to the optic nerve. Why is the retina so closely connected with the optic nerve? Place it in water, where it will resume its normal shape and the retinal vessels will stand out clearly.

Separate the remaining portions of sclera and choroid with your forceps, freeing the two coats from each other as far as the optic nerve. Cut the choroid free of the optic nerve with your scissors. Place the choroid in water and observe

its iridescent blue appearance. This is caused by a reflecting layer, the *tapetum*. The tapetum, not present in humans, is the layer that reflects light from the eyes of many animals at night.

Examine the isolated sclera. Note its firmness and strength. The head of the optic nerve can be seen penetrating it. The lens, which in life is a clear body, will be made up of concentric layers of fibers. Note that you can peel off successive layers of them.

The two methods of study of eye structure described above have been used successfully in a number of high schools. Teachers of high school biology testify that this much detail can be grasped by average students. Teachers further testify that real interest and understanding appear to displace the apathy once so evident.

Steer eyes are sold by slaughter houses at prices ranging from two to ten cents apiece. Such prices should be within the reach of a proper high school science budget. Economy may be practiced by careful treatment of the bisected eyes which can be used over and over by successive classes.

Why not take the frustrated "bench warmers" out of your "audience", bring them face to face with original material, and give them the much needed benefit of active participation?

What Not to Teach About a "Balanced" Aquarium

JAMES W. ATZ
New York Aquarium, New York Zoological Society

One hundred years ago Robert Warington, English chemist, presented a paper to the Chemical Society of London in which the theory of the balanced aquarium was enunciated formally for the first time. Since then, the idea that the animals and plants of an aquarium balance each other in their production and consumption of carbon dioxide and oxygen has been unequivocally accepted by practically all aquarists, scientists and teachers—even though it was shown in 1931 that the concept is an erroneous one.

Warington was not the first to keep fish and aquatic plants together, nor was he the first to suppose that in water plants benefit animals, as far as respiratory gases are concerned, the way that they do on land.[1] He was, however, the first clearly to apply the conception of mutual interdependence of plants and animals to small containers of water, and because the results of his experiment with goldfish and tape grass (*Vallisneria*) became much more widely known than those of any other investigator, he may perhaps be considered the Father of the Balanced Aquarium. What he said a century ago can be used as a summation of what the very great majority of people believe today: "Thus we have that admirable balance sustained between the animal and vegetable kingdoms, and that in a liquid element. The fish, in its respiration, consumes the oxygen held in solution by the water as atmospheric air; furnishes carbonic acid; feeds on the insects and young snails; and excretes material well adapted as a rich food to the plant and well fitted for its luxuriant growth."

[1] ATZ, JAMES W. The Balanced Aquarium Myth. *Aquarist and Pond-keeper*, vol. 14, no. 7, pp. 159–160; no. 8, pp. 179–182. 1949.

About 40 different kinds of aquatic plants are commercially available today for small standing aquaria, making possible a wide variety of both decorative and natural effects as exemplified by this tank of small Characins. New York Zoological Society Photo.

"The plant, by its respiration, consumes the carbonic acid produced by the fish, appropriating the carbon to the construction of its tissues and fibre, and liberates the oxygen in its gaseous state to sustain the healthy functions of the animal life, at the same time it feeds on the rejected matter which has fulfilled its purposes in the nourishment of the fish. . . ."[2]

It was Dr. Charles M. Breder, Jr., at that time Research Associate of the New York Aquarium, who demonstrated the falsity of Warington's thesis.[3] The oxygen dissolved in aquarium water comes not from the plants, but from the atmosphere. Breder found that the slightest over or under saturation of oxygen in tank water returned very quickly to equilibrium with the air above, whether or not plants were present or whether measurements were taken in bright sunlight or in the dark. Obviously plants could not have been affecting the oxygen content of the water to any significant extent. The oxygen was coming in from the air as fast as the smallest deficiency in the water existed. Except under extraordinary conditions there is never any lack of oxygen in an aquarium.

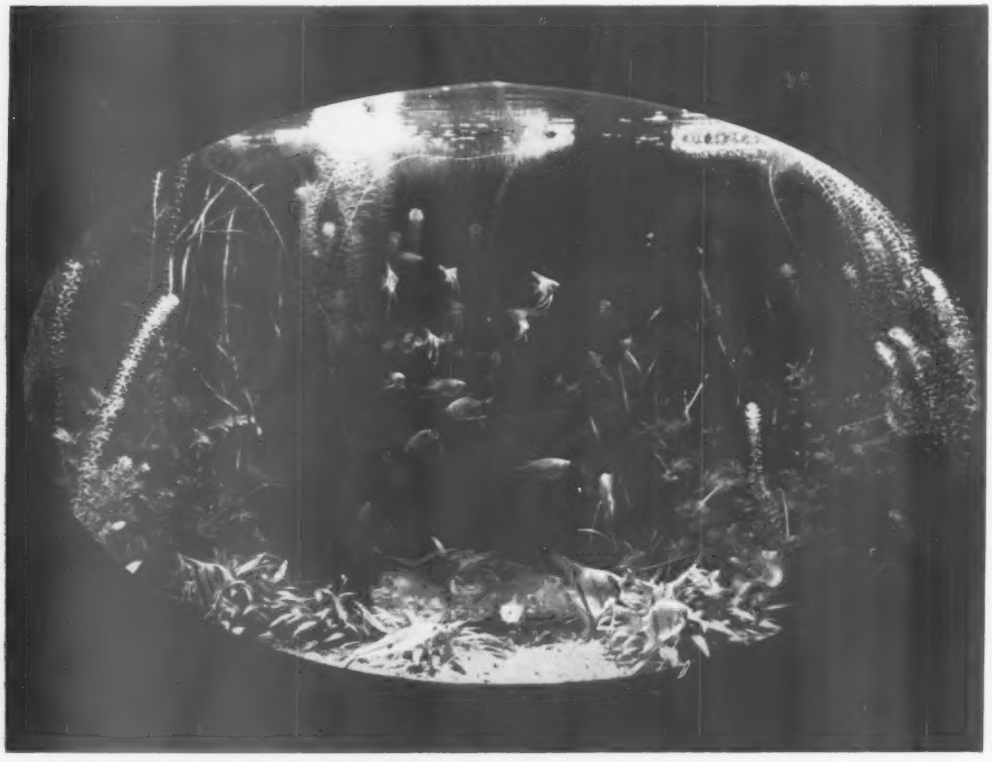
How is it, then, that fishes seem to smother so obviously—in an overcrowded aquarium for example? The answer is that carbon dioxide causes their distress and eventually kills them. Physiologists have discovered that fish can be killed by carbon dioxide even though there is plenty of oxygen present. Breder found

[2] WARINGTON, ROBERT. Notice of observations on the adjustment of the relations between animal and vegetable kingdoms, by which the vital functions of both are permanently maintained. *Quart. Jour. Chemical Soc.*, vol. 3, pp. 52–54. 1851.

[3] BREDER, CHARLES M., JR. On the organic equilibria in aquaria. *Copeia*, no. 2, p. 66. 1931.

that this gas moves in and out of water much more slowly than oxygen. When aquatic plants were actively engaged in photosynthesis, the carbon dioxide concentration in tank water remained far below the equilibrium point. In other words, the plants were using up the carbon dioxide more rapidly than it could enter the water from the air. Similarly, the amount of dissolved carbon under extraordinary conditions. Aerating a tank does not increase the oxygen content of the water, as commonly believed, but facilitates the escape of carbon dioxide.

A simple demonstration that plants are not essential to any so called balanced aquarium is to remove all of them from such a tank; the fish will show no respiratory distress whatsoever.



A variety of aquatic plants, including *Anacharis, Myriophyllum, Vallisneria, Cabomba* and *Cryptocoryne*, make this 300-gallon tank a more natural environment for the several species of small tropical fishes inhabiting it. New York Zoological Society Photo.

dioxide can build up in an aquarium more rapidly than it can escape into the atmosphere. The fishes are then unable to adjust themselves to the excessive accumulation of carbon dioxide and may die—even though there is plenty of oxygen all around them.

An excess of carbon dioxide, not a lack of oxygen smothers fish, except

Plants, however, do serve many useful functions in aquaria, including (1) provision of a more natural habitat for fishes, (2) prevention of the growth of algae, (3) provision, both directly and indirectly, of food for fishes, (4) sheltering of less dominant fishes from attacks of their more aggressive neighbors, (5) furnishing of sites for eggs and protec-

tion for young and (6) decoration of the tank.[4]

Although this correction of viewpoint does not entail any change in generally accepted aquarium practice (since aquarists have been doing essentially the right thing, but for the wrong reasons), it does mean that in biology teaching, an aquarium cannot be used to demonstrate the mutual interdependence of plants and animals in their production and consumption of carbon dioxide and oxygen. The physiology of plants and animals in an aquarium is identical with the physiology of those in the world at large, but the part they play in the ecology, or bionomics, of their tank is quite different from that taken by the sum total of all life in the earth's grand economy. An aquarium is not a microcosm, not a system isolated from the outside world. This was Warington's fundamental error and that of all who preceded and followed him.

Robert Bullington has pointed out some of the biological principles that can legitimately be demonstrated with the viviparous top-minnow, *Gambusia*.[5] Closely related tropical fishes like the guppy, platy, swordtail and mollie will serve essentially the same purpose, and the numerous freshwater fishes, invertebrates and plants available both from tropical fish dealers and biological supply houses give the teacher of biology a wide selection of hardy and reasonably priced living aquatic material for the classroom and laboratory. Small aquaria should not be used to illustrate the respiratory interdependence of plants and animals; they are nevertheless essential to any well rounded biology course. Life in water is so different from that on land that no real appreciation of it can be engendered without actually showing it to the student—in the classroom, the public aquarium and the field.

[4] ATZ, JAMES W. The Functions of Plants in Aquaria. *Aquarium Jour.*, vol. 21, no. 2, pp. 40–43; no. 3, pp. 56–60. 1950.

[5] BULLINGTON, ROBERT A. Teaching biology with Gambusia. *The American Biology Teacher*, vol. 9, no. 9, pp. 261–264. 1947.

NEW FOOD LABORATORY

A food technology laboratory to investigate the application of chemicals in the food industry has been established at Anniston, Alabama, by the Monsanto Chemical Company of St. Louis, Missouri.

The laboratory will serve Monsanto's six operating divisions on problems related to food and food processing and will act as liaison with the food industry, university and government laboratories.

The laboratory's current projects range from candy molding to juice extraction. Studies are also planned in food preparation, preservation and packaging.

FILMS

Dr. N. E. Bingham of Northwestern has just completed work on a new 16mm educational motion picture, *Life In A Pond*, produced and released this month by Coronet Films. An associate professor in the teaching of science at Northwestern, Dr. Bingham served as Educational Collaborator for this film.

As such he was consulted by the Coronet script and production departments during the year in which this motion picture was being prepared. *Life In A Pond* is designed for general science courses and through the magic of microphotography permits audiences to see a wealth of fascinating plant and animal life that lives on and beneath the surface of a pond.

Coronet Films, nation's largest producer of 16mm instructional motion pictures, now has a library of more than 300 titles. *Life In A Pond* will be part of Coronet's growing series of biology films now used by schools across the nation.

AUTHORS' MANUAL

John Wiley & Sons announced the publication in February of *Author's Guide*, a new book designed to aid the technical and scientific writer. The new volume is a start-to-finish manual on the most efficient methods of handling manuscript, illustrations, and proof. It shows the technical author how his manuscript progresses through principal stages on its way to publication, acquainting him with the functions of several hundred skilled and experienced workers required to bring his work to the printed page.

Additional information is included on formal publication and copyright, preparing for reprinting, revisions and new editions, and on details of editorial style. The end papers of the book contain a table of do's and don'ts which every prospective author will find valuable. The publishers hope to enlist the cooperation of technical authors before their manuscripts are prepared—to plant economies which will prevent technical book production costs from rising to prohibitive levels. The price of *Author's Guide* is $2.00.

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Manuscripts for publication in THE AMERICAN BIOLOGY TEACHER should be typewritten, on one side only, on standard white paper, $8\frac{1}{2} \times 11$ inch size, with a margin of at least an inch on all sides. The writer should keep a carbon copy for reference and as insurance against loss of the original in transit.

Articles are scheduled for publication in approximately the order of acceptance of the manuscripts. Generally the journal is tentatively arranged about three or four issues ahead, and there are under consideration at any time enough manuscripts for about two or three more issues. Some space is of course allowed for news items and articles of a seasonal nature. On the average, a manuscript submitted this month may expect to find its way into print, if it is accepted promptly, in about May or October. Many seasonal papers have to be postponed an entire year, simply because the author has not allowed the necessary four to six months that intervenes between acceptance and publication.

For details concerning titling, headings, references, illustrations, etc., consult *Preparation of Manuscripts for Publication*, which appeared in the October, 1943, issue of THE AMERICAN BIOLOGY TEACHER. A limited number of reprints is still available; copies may be obtained from the editor.

Manuscripts may be sent to the editor-in-chief or to any one of the associate editors. A complete list of the latter appears in each October and February issue.

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